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FOREIGN TECHNOLOGY DIVISION

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by

L. D. Garbar

EDITED TRANSLATION

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А а	*А а*	A, a	Р р	*Р р*	R, r
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В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ë in Russian, transliterate as yë or ë. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	A	α		Nu	N	ν	
Beta	B	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	O	o	
Delta	Δ	δ		Pi	Π	π	
Epsilon	E	ε		Rho	P	ρ	
Zeta	Z	ζ		Sigma	Σ	σ	ς
Eta	H	η		Tau	T	τ	
Theta	Θ	θ		Upsilon	T	υ	
Iota	I	ι		Phi	Φ	φ	ϕ
Kappa	K	κ		Chi	X	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	M	μ		Omega	Ω	ω	

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}
rot	curl
lg	log

GRAPHICS DISCLAIMER

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SOME RECOMMENDATIONS ON THE USE OF BEACH SAND AS AN AGGREGATE FOR FAM POLYMER-CONCRETES

L. D. Garbar, Odessa Engineering-Construction Institute

FAM polymer-concrete, as with other concretes, is a multi-component material. Its binding part is made from the FAM-brand furfural-acetone monomer and a hardener - benzosulfonic acid (BSK). The properties of the FAM polymer-concrete are not determined just by the type and quantity of the binder. Equally, if not to a greater degree, they depend on the type, quality, and quantity of aggregates. As a large or small aggregate for the FAM polymer-concrete many rocks and minerals are useful, although the use of aggregates with impurities of carbonate particles are intolerable, since with the interaction of an acidic hardener of the polymer-concrete with

carbonate impurities carbon dioxide escapes and the compound swells up. Here either hardening does not occur at all, or the polymer-concrete acquires an extremely low strength. However, what has been said does not give grounds in all cases to stop using aggregates with impurities of carbonate particles. Thus, I. M. Yelshinyy acquired a strong FA polymer-concrete on barhan sand with high content of carbonate impurities.

99ta Beach sand also has in its composition carbonate impurities in the form of residues of dead shelly organisms. The use of them as aggregates for the FAM polymer-concrete would be economically advisable, since beach sand is the local material of many regions of our country.

In the Laboratory for Plastic Structural Elements of the Odessa Engineering-Construction Institute we conducted experiments on the acquisition of FAM polymer-concretes on beach sand containing up to 28 percent carbonate particles. For the study, we took coarse beach sand with a dimension of the particles up to 2.5 mm containing 12 percent mussel; fine beach sand with a dimension of the particles up to 0.6 mm, containing 28 percent mussel.

Attempts to completely remove the carbonate particles by sifting and washing proved unsuccessful. Besides this, other materials were

used:

a) granitic gravel with a fraction up to 10 mm;

b) fine casting quartz sand with size of the particles up to 0.14 mm;

c) quartz meal GOST (All-Union State Standard) 9077-59;

d) commercial-grade sodium fluosilicate GOST 87-66;

e) "Arzamit-5" powder, consisting of ground graphite and a hardener - toluenesulfochloride (TU [Technical Specification] 6-16-1133-67, residue on screen 0.42 mm - 5 percent);

f) modernized furfurol-acetone monomer (FAM) of the Ferganskiy Chemical Plant for Furan Compounds;

g) a hardener - benzosulfonic acid (BSK) of the Novomoskovskiy Chemical Plant, TY No. GAP-V-25-66.

Prepartion of the polymer-concrete was done by standard technology in accordance with the Ferganskiy ONIL (Odessa Scientific Research Institute) and TsNIIPodzemshakhtstroy (Central Scientific

Research, Planning and Design Institute of Underground Mine Construction).

The ingredients of FAM polymer-concrete were selected experimentally on the principle of the greatest density of the mixture, the smallest expenditure of resin, and the necessary miscibility. After preparation, part of the specimens were subjected to dry heating at a temperature of +80°C for a period of 24 hours, and the rest were kept in normal room conditions until the test. It is interesting to note that the part of the specimens which were subjected to heat treatment and which have in their composition fine beach sand or its mixture with coarse sand had traces of swelling on all side faces as a result of the examination, although such was not the case with the specimens which were not subjected to dry heat. This means that in this case heating was an accelerator of the reaction between the hardener and the carbonate particles.

After the examination, the 4x4x4 cm specimen-cubes which were subjected to heat treatment and the specimens which were kept under normal room conditions for periods of 7 and 28 days were tested for compression in a hydraulic press with a speed of application of a load equal to 10-15 kg/cm² per second. Furthermore, on 4x4x16 cm specimens-prisms we determined the modulus of elasiticity of the FAM polymer-concrete with compression.

Altogether 22 compcunds were tested with the use of both the beach sand themselves and their mixtures with cther materials. The most characteristic of the studied compounds, and also the test results, are presented in the table.

Comparing the indicators of the studied compounds, it is easy to note that the use of fine beach sand, and also its mixtures with coarse sand as aggregates for FAM polymer-concrete, is impermissable, since the high content of carbonate particles leads to swelling of the mixture and, although the latter will harden, the strength and modulus of elasticity with compression is insignificant. So to talk in general about FAM polymer-concrete of such lcw strength with its comparatively high cost does not make economically or technically substantiated sense. We can talk to some degree on the use of light, swcllen, and hardened polymer-concrete in this case. This question requires special consideration and, in the cpinion of the author, such a polymer-concrete will hardly have other valuable indicators which FAM polymer-concretes generally have.

With the use of only coarse beach sand as an aggregate swelling is not observed. This is explained, apparently, by the fact that the carbonate particles in coarse beach sand are in the form of coarse

shelly particles with low specific surface and strong natural cohesion, and reactions in this case do not occur.

The picture sharply changes with the replacement of the fine beach sand by fine quartz sand. The strength and modulus of elasticity grow noticeably. Compounds on granitic gravel and mixtures of beach sand where the fine beach sand does not exceed the amount of 15 percent by weight also possess sufficiently high indicators. Particularly effective are the additives quartz meal (8-10 percent by weight), fluosilicate of sodium [2] or "Arzamit-5" powder, recommended by the author (2-3 percent by weight).

Of the two additives a preference should be given to the additive "Arzamit-5" powder, since the addition of fluosilicate of sodium to mixtures with beach sand for an unknown reason led to a still more intensive swelling, while at the same time the addition of "Arzamit-5" powder, although having less effect on strength, serves as sort of an "extinguisher" of swelling.

As is shown in further studies, the addition of "Arzamit-5" powder also leads to an increase of water resistance of the FAM polymer-concrete. This is explained by an increase of density of the mixture and the presence of ground graphite in the powder, which adds hydrophobic qualities to the concrete.

Conclusions

1. Fine beach sand as independent aggregates for FAM polymer-concrete is disadvantageous. Their use is permitted in quantity no more than 15 percent by weight for the mixture of granitic gravel, coarse beach sand, and finely-ground aggregates.

2. Coarse beach sand, because of the increased hollowness, must be used with additions of finely-ground aggregates. Fine beach sand is not suitable as such an additive.

Figure. Table of the studied compounds of the FAM polymer-concrete on beach sands

Key: 1. Components of the polymer-concrete. 2. Number of the studied compounds of FAM polymer-concrete (in percent by weight). 3. Granitic gravel. 4. Coarse beach sand. 5. Fine beach sand. 6. Fine quartz sand. 7. Quartz meal. 8. Fluosilicate of sodium. 9. "Arazmit-5"

powder. 10. FAM monomer. 11. Hardener - benzosulfonic acid. 12. Some indicators of the FAM polymer-concrete with the use of beach sand. 13. Volumetric weight, g/cm³. 14. Compression strength, kg/cm², after. 15. 7 days. 16. Dry heating. 17. Modulus of elasticity, kg/cm²x10³, after heating.

(1) Составляющие полимербетона		(2) № исследуемых составов полимербетона ФАМ (в % по весу)																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
(3) Щебень гранитный		—	—	—	—	—	—	—	—	—	—	51	51	51	51	51	51	51	51	51
(4) Крупный морской песок		—	85,5	45,5	45,5	45,5	45,5	45,5	38,1	38,1	38,1	19,5	19,5	19,5	19,5	19,5	19,5	14,5	14,5	14,5
(5) Мелкий морской песок		85,5	—	40	38	—	—	—	—	—	—	17,0	15	15	—	—	—	—	—	—
(6) Тонкий кварцевый песок		—	—	—	—	40	38	38	25,4	25,4	25,4	—	—	—	17	15	15	12	12	12
(7) Кварцевая мука		—	—	—	—	—	—	—	22	20	20	—	—	—	—	—	—	10	8	8
(8) Кремнефтористый натрий		—	—	—	—	—	2	—	—	2	—	—	2	—	—	2	—	—	2	—
(9) Порошок «Арзамит-5»		—	—	—	2	—	—	2	—	—	2	—	—	2	—	—	2	—	—	2
(10) Мономер ФАМ		12	12	12	12	12	12	12	12	12	12	10	10	10	10	10	10	10	10	10
(11) Отвердитель — бензолсульфокислота		2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
(12) *Некоторые показатели полимербетонов ФАМ с применением морских песков*																				
(13) Объемный вес, *г/см³*		2,01	2,16	1,93	2,16	2,17	2,16	2,17	2,20	2,20	2,19	2,32	2,31	2,31	2,33	2,33	2,33	2,34	2,34	2,34
(14) Прочность при сжатии, *кг/см²*, после	7 суток (15)	123	190	120	270	303	298	440	630	672	650	461	601	584	590	694	642	687	750	703
	28 суток	140	210	153	294	350	347	457	695	703	694	483	630	603	627	760	700	698	780	764
	сухой прогрев (16)	103	290	148	348	448	440	529	804	850	790	520	710	674	710	872	802	863	980	920
(17) Модуль упругости, *кг/см²*×10³, после прогрева		—	97	68	87	93	112	140	165	230	190	160	200	190	175	263	258	243	270	265

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